

PCT

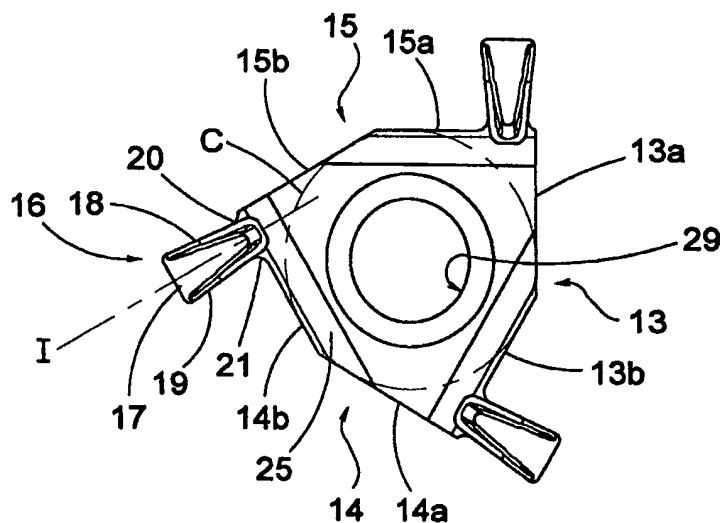
WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : B23B 27/16, 27/04, 27/06	A1	(11) International Publication Number: <b>WO 99/34947</b> (43) International Publication Date: 15 July 1999 (15.07.99)
(21) International Application Number: PCT/SE98/02372 (22) International Filing Date: 17 December 1998 (17.12.98) (30) Priority Data: 9704871-4 22 December 1997 (22.12.97) SE (71) Applicant (for all designated States except US): SANDVIK AB (publ) [SE/SE]; S-811 81 Sandviken (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): TÄGTSTRÖM, Pär [SE/SE]; Ärtvägen 11, S-811 62 Sandviken (SE). (74) Agent: BENTON, Richard; Sandvik AB, Patent Dept., S-811 81 Sandviken (SE).		(81) Designated States: CN, JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published With international search report. In English translation (filed in Swedish).

(54) Title: INSERT FOR THE CUTTING OF GROOVES



(57) Abstract

The present invention relates to an indexable cutting insert (10) for the turning of grooves with triangular basic shapes where each insert corner features a projection (16). Each projection supports a transverse cutting edge (17) and connecting diverging cutting edges (18, 19), so that the projection (16) seen in a view directly from above has a symmetrical shape. The one outer side edge (18) of the projection (16) is bordered by an unbroken flat flank surface (22) whilst the connecting flank surface on the other side edge (19) is comprised of two partial surfaces (27, 28) of which the one nearest the edge (19) partial surface (27) has a smaller clearance angle than the partial surface (28) nearest the bottom.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## INSERT FOR THE CUTTING OF GROOVES

The present invention relates to an indexable cutting insert with a basically triangular shape for the turning of grooves, said insert comprising an upper surface, a lower surface, which is substantially parallel to the upper surface, plus the edge surfaces which connect them. Each cutting corner of the insert is provided with a projection, which carries a cutting edge arranged substantially at right angles to the direction of the groove. The edges of the insert projection, which are connected, to the cutting edge diverge in the direction of the groove so that the projection has a symmetrical shape in relation to the direction of grooving. Each projection is arranged almost entirely outside a triangle which is defined by an imaginary circle which is inscribed round the centre of the insert and which has the outer surfaces of the insert cutting the circle tangentially.

Triangular, indexable inserts for grooving, which are known from prior art, have designs, which require a relatively large amount of cemented carbide. Cemented carbide is expensive and therefore it is economically advantageous if each insert requires as little cemented carbide as possible. The designs of known inserts are such that holders are required with insert seats especially designed for each insert size. Further accessibility with known inserts in confined spaces is very limited.

20

One object of the present invention is to design an indexable insert so that only a reduced volume of cemented carbide is required for its manufacture.

Another object is to design the geometry of the insert so that they can be formed with a larger volume of insert material under the cutting edge when the tool is to be used for axial grooving. Greater grooving depths thereby become possible.

25

A further object is to create an insert with three cutting edges, which can be indexed as required.

30

A further object is to design an insert so that it can satisfactorily manage the first incut during which a long unbroken chip is normally formed.

The invention is more closely described hereinafter with reference to the appended  
5 figures.

FIG. 1 shows a cutting insert for grooving according to the invention in a side view.

FIG. 2 shows the insert in a top view.

10

FIG. 3 shows the cutting corner of the insert in a top view.

FIG. 4 shows a cross section of the cutting corner according to the line A - A in FIG. 3.

15 FIG. 5 shows a cutting insert, in a front view, in cutting action in an axial grooving operation.

FIG. 6 shows part of a tool for grooving, in a top view, comprising an insert according to the invention.

20

FIG: 1 and 2 show an indexable insert (10) for grooving. The insert (10) has a triangular basic shape and comprises an upper surface (11) and a lower surface (12) plus the connecting side surfaces (13, 14, and 15). The sides (11, 12) are substantially parallel. The side surfaces (13 - 15) connect the sides at substantially right angles. The cutting  
25 insert is provided with a centre hole (29), which extends substantially at right angles to the sides (11, 12). Each edge surface, e.g. (13), consists of two, in relation to each other, convex, stepped, planar parts (13a, 13b), of which one part (13a) is arranged to act as a support surface against an insert seat. The part (13b) is arranged in such a way that contact is avoided with the workpiece during the grooving operation. The part (13a)  
30 forms part of a side of an imaginary triangle, defined in such a way that its three sides cut tangentially a circle (C) inscribed around the centre of the insert (10). The part (13b)

forms a tangent to the circle (C) in the same way as part (13a). The insert has three cutting corners, which are identical, and therefore from here on only one is described. A projection (16) is provided at each cutting corner, which links the parts (15b) and (14b). The projection has a substantially straight cutting edge, which is substantially parallel to the part (14b). The cutting edge (17) is connected via its ends to the edges (18, 19), which converge in the direction inwards from the cutting edge. The cutting edge (17) is substantially at right angles with the grooving direction, which is marked (I). The edges (18, 19) form a sharp angle with each other which is in the range 1 to 10°, preferably 3 to 5° so that the projection (16), as seen in a view directly from above, has a symmetrical shape in relation to the direction of grooving (I). The edge (18) retains its direction until it connects to the part (15b) via a concave edge (20). The edge (19) connects, in a similar manner, to part (14b) via a concave edge (21). The surface (22) beneath edge (18) forms a clearance angle ( $\alpha$ ). The surface (23) below the cutting edge (17) on the other hand forms a 90-degree angle with the plane, which includes the bottom surface (12). A rake face (24) slopes inwards and downwards from the cutting edge (17) and forms a sharp wedge angle with surface (23). An inward and upward sloping rear surface (25) connects to the rake face (24) via a rounding off (26). The rear surface (25) is connected also to the upper surface (11) of the insert.

The surface (27) below the edge (19) is straight and unbroken from the upper side of the insert a distance downwards until it forms a clearance angle ( $\beta$ ). The surface (27) then connects via an obtuse angle to the lower surface (28) which extends uninterrupted all the way down until it forms an intersection in the form of an obtuse angle with a slanting upwards sloping bottom surface (29) of the projection (16). The clearance angle of the surface (27) is shown as ( $\gamma$ ).

A chip forming dimple (30) is formed centrally on the upper side of the projection (16), the said dimple cuts through the main cutting edge (17), so that it features in its middle part a bowed, depressed cutting edge portion (17a). The chip breaking dimple is in its turn divided into a forward (31) and a rear (32) dimple part, the latter being superimposed the former, whereby the bottom of the latter is located higher than the bottom (31) of the forward part of the dimple. This means that the forward part (31) has

forms a tangent to the circle (C) in the same way as part (13a). The insert has three cutting corners, which are identical, and therefore from here on only one is described. A projection (16) is provided at each cutting corner, which links the parts (15b) and (14b). The projection has a substantially straight cutting edge, which is substantially parallel to the part (14b). The cutting edge (17) is connected via its ends to the edges (18, 19), which converge in the direction inwards from the cutting edge. The cutting edge (17) is substantially at right angles with the grooving direction, which is marked (I). The edges (18, 19) form a sharp angle with each other which is in the range 1 to 10°, preferably 3 to 5° so that the projection (16), as seen in a view directly from above, has a symmetrical shape in relation to the direction of grooving (I). The edge (18) retains its direction until it connects to the part (15b) via a concave edge (20). The edge (19) connects, in a similar manner, to part (14b) via a concave edge (21). The surface (22) beneath edge (18) forms a clearance angle ( $\alpha$ ). The surface (23) below the cutting edge (17) on the other hand forms a 90-degree angle with the plane, which includes the bottom surface (12). A rake face (24) slopes inwards and downwards from the cutting edge (17) and forms a sharp wedge angle with surface (23). An inward and upward sloping rear surface (25) connects to the rake face (24) via a rounding off (26). The rear surface (25) is connected also to the upper surface (11) of the insert.

The surface (27) below the edge (19) is straight and unbroken from the upper side of the insert a distance downwards until it forms a clearance angle ( $\beta$ ). The surface (27) then connects via an obtuse angle to the lower surface (28) which extends uninterrupted all the way down until it forms an intersection in the form of an obtuse angle with a slanting upwards sloping bottom surface (29) of the projection (16). The clearance angle of the surface (27) is shown as ( $\gamma$ ).

A chip forming dimple (30) is formed centrally on the upper side of the projection (16), the said dimple cuts through the main cutting edge (17), so that it features in its middle part a bowed, depressed cutting edge portion (17a). The chip breaking dimple is in its turn divided into a forward (31) and a rear (32) dimple part, the latter being superimposed the former, whereby the bottom of the latter is located higher than the bottom (31) of the forward part of the dimple. This means that the forward part (31) has

gradually increasing depth inwards towards the insert and then decreasing depth. The transition between these two parts of the dimple is in the form of a border line (33) or an equivalent radial transition. The borderline (33) is shaped as a substantially equally sided point which points towards the main cutting edge (17). Two ridges (34, 35) are provided along opposite sides of the dimples which extend in the inserts longitudinal direction and diverge at a slight angle, they are positioned at the same height or somewhat higher than the plane which is defined by the side edges (18, 19). The ridges extend forwards until they transform in the proximity of, but not right up to, the main cutting edge (17) into two fingers, (36, 37) which diverge at a relatively large angle. By arranging ridges in the manner described above it is possible to ensure that the chips will remain in contact with the forward part of the ridges or fingers (36, 37) and that the central part of the chip is brought deeper down into the dimple (31), which means that the total breadth of the chip will be smaller and that it will be easier to handle and that no damage to the sidewalls of the dimple will be caused by the chip during the machining of a metal workpiece by the insert. Furthermore it is essential that the V-shaped transition line is the upper border line of a slanting backwards sloping wall, against which the chip comes into direct contact during machining, after which it is brought upwards to the same level as the upper surface (11) along which it slides backwards. At both moderate and more powerful rates of feed chip formers, as described above, have proved to contribute to the chips being formed in an advantageous manner and that at the same time a certain reduction in the cutting forces can be obtained. Characteristic for the design of the new insert is the projections, which are formed at each corner of the insert. Thanks to the double angled form of the surface parts (27) and (28) of the protrusion (16), it becomes possible to manufacture an insert via direct pressing, with a strong cutting edge area (17) as compared to if the side surfaces (27, 28) were to have been built up of an unbroken surface with one and the same angle of slope. In FIG. 5 it has been shown more closely how the insert described above is intended for axial grooving in a workpiece (A). The clearance angle of the surface (22) is denoted as ( $\alpha$ ) and it should be between 1 - 8 °, preferably 3 - 6°. The clearance angle of the surface (27) is denoted as ( $\beta$ ), which should be 3 - 12°, preferably

5 - 8° and the clearance angle for the lower flank (28) with ( $\gamma$ ), this angle should be in the range 10 - 30°, preferably 15 - 20°.

FIG. 6 shows an example of a tool for grooving, comprising an insert (10) of the type  
5 shown in FIGS. 1 and 2. The tool includes a holder (38) with an insert seat (40) fixed in the holder (38) by means of a threaded screw (39). The insert (10) is locked against the insert seat by a screw (41), which is screwed into a threaded bore in the holder. It can be readily understood from FIG. 5 that the eccentric position of the screw (41) in relation to the hole (29), in the insert that the insert will be pressed in a direction corresponding to  
10 that of the arrow (P). The insert is thereby brought, in a reliable manner, to abut with two of its sides (13a) and (13b) against corresponding sides in the insert seat (40).



Claims

1. Indexable insert for the turning of grooves, the basic shape of said insert being triangular, comprising an upper surface (11), a lower surface (12) which is substantially parallel to the upper surface plus connecting side surfaces (13, 14, 15), the insert's cutting corners are provided with projections (16), which carry a cutting edge (17) arranged substantially at right angles to the direction of grooving (I) of the insert, wherein the edges (18, 19) of the projection which are connected to the cutting edge diverge in the said direction of grooving (I), characterized in, that the combination of each projection (16) is arranged totally outside a triangle which is defined by an imaginary inscribed circle (C) against which the edge surfaces of the insert (13, 14, 15) lie tangentially, and that the flank (22) which is connected to one side edge of the projection (18) has one uninterrupted flat surface whilst the flank connected to the other side surface (19) is composed of two partial surfaces (27, 28) which intercept each other with an obtuse angle.
2. Indexable insert according to claim 1, characterized in, that the flank surface (27) nearest the edge (19) slopes with a clearance angle ( $\beta$ ) which is less than the clearance angle ( $\gamma$ ) of the flank surface (28) adjacent to the bottom surface (29).
3. Indexable insert according to claims 1 or 2, characterized in, that the surface (23) situated below the cutting edge (17) is arranged so that it forms a right angle with the plane which encloses the bottom surface (12) of the insert.
4. Indexable insert according to any of the claims 1 - 3, characterized in, that the rake face includes two dimples (31, 32) of different depths, which are surrounded on either side by ridges (34, 35) and (36, 37) extending in the longitudinal direction of the projection (16), which converge the further out they are, the rear ridges (34, 35) converge at a somewhat smaller angle than that of the forward ridges (36, 37).

5. Indexable insert according to any of the claims 1 - 4, characterized in, that the transition between the chip forming dimples (31, 32) on the forward upper side of the insert is made up of an equal sided point which points in the direction of the cutting edge (17).

5

6. Indexable insert according to any of the claims 1 - 5, characterized in, that the projection (16) has a symmetrical shape in relation to the direction of grooving (I) and when seen in a view from directly above.

10 7. Indexable insert according to any of the claims 1 - 6, characterized in, that the clearance angle ( $\alpha$ ) of the one flank surface (22) on the projection (16) is 1 - 8° at the same time as the clearance angle ( $\beta$ ) on the opposite flank surface (27) nearest the upper side is 3 - 12°.

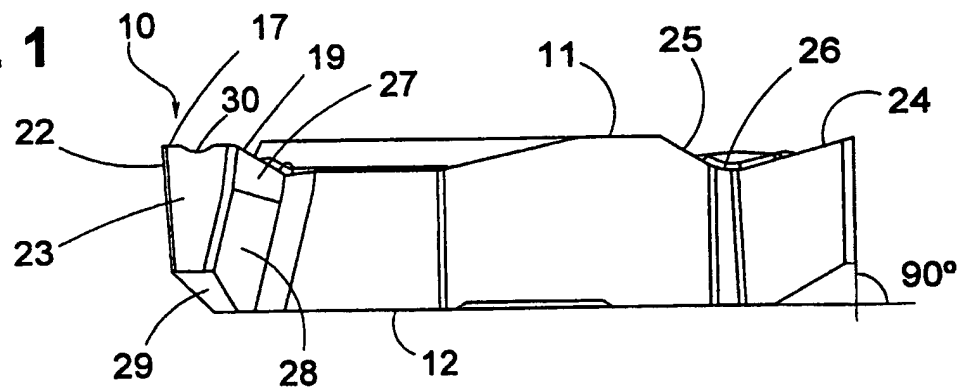
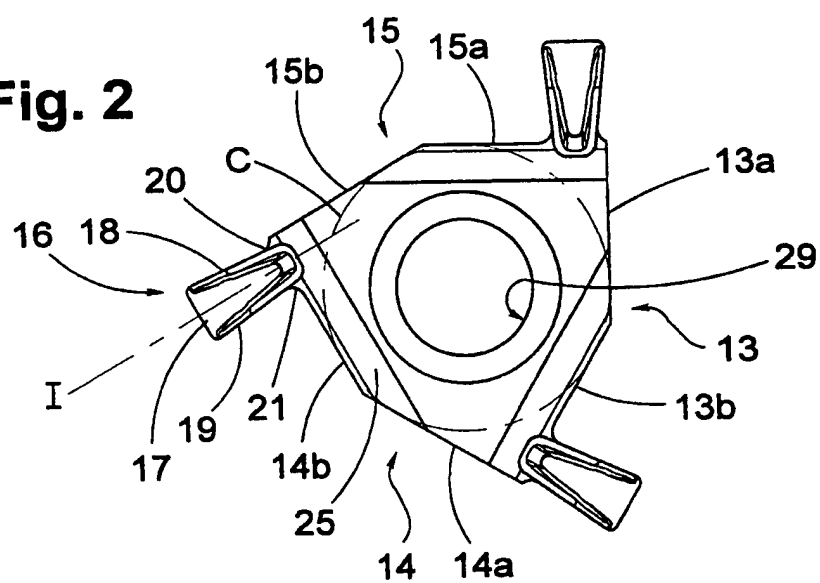
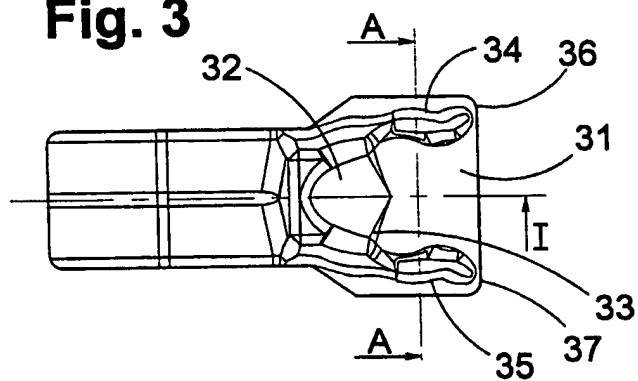
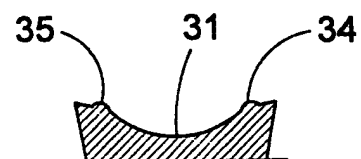
15 8. Indexable insert according to any of the claims 1 - 7, characterized in, that the clearance angle ( $\gamma$ ) on the flank surface (28) below the flank surface (27) is 10 - 30°.

9. Indexable insert according to claim 7, characterized in, that the clearance angle ( $\alpha$ ) is 3 - 6°, and that the clearance angle ( $\beta$ ) is 5 - 8°.

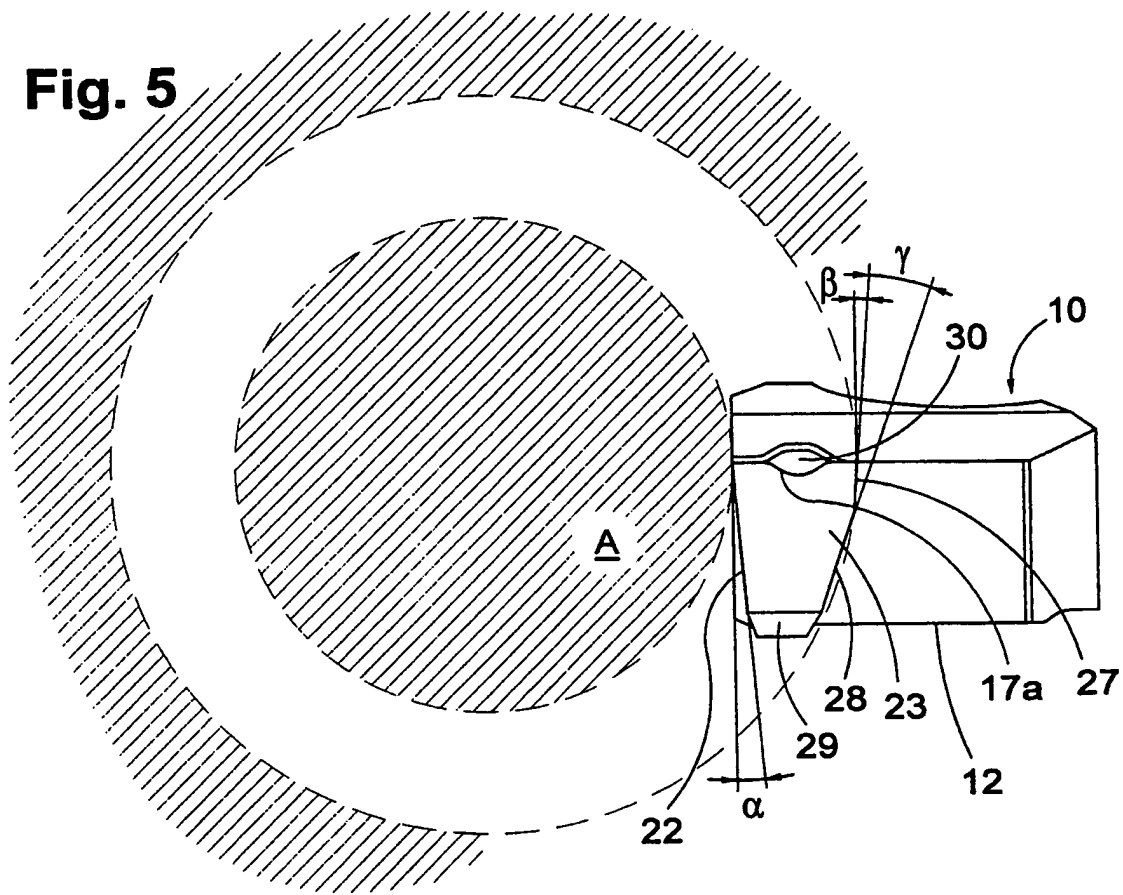
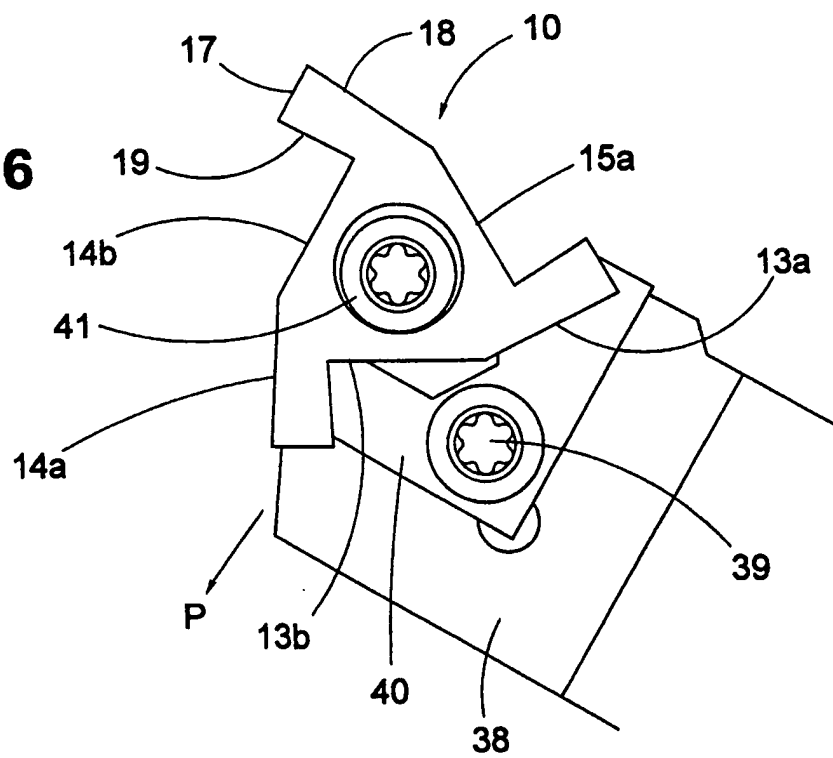
20

10. Indexable insert according to claim 8, characterized in, that the clearance angle ( $\gamma$ ) is 15 - 20°.

1/2

**Fig. 1****Fig. 2****Fig. 3****Fig. 4**

2/2

**Fig. 5****Fig. 6**

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/02372

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B23B 27/16, B23B 27/04, B23B 27/06  
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B23B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE 451552 B (SANDVIK AB), 19 October 1987 (19.10.87), figure 1 --	1-10
A	EP 0162029 A2 (SANTRADE LTD.), 21 November 1985 (21.11.85), figures 2,3, abstract --	1-10
A	EP 0596844 A1 (SANDVIK AKTIEBOLAG), 11 May 1994 (11.05.94), figure 1, abstract -- -----	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

12 March 1999

Date of mailing of the international search report

21 -03- 1999

Name and mailing address of the ISA/  
Swedish Patent Office  
Box 5055, S-102 42 STOCKHOLM  
Facsimile No. +46 8 666 02 86

Authorized officer

Joakim Movander  
Telephone No. +46 8 782 25 00

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

02/02/99

International application No.  
**PCT/SE 98/02372**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE 451552 B	19/10/87	DE 3685746 A	23/07/92
		EP 0232692 A,B	19/08/87
		SE 0232692 T3	
		JP 1745509 C	25/03/93
		JP 4029485 B	19/05/92
		JP 7092064 B	09/10/95
		JP 62193707 A	25/08/87
		JP 63501887 T	28/07/88
		KR 9408172 B	07/09/94
		SE 8600557 A	11/08/87
		US 4755085 A	05/07/88
EP 0162029 A2	21/11/85	JP 1688623 C	11/08/92
		JP 3051525 B	07/08/91
		JP 61008204 A	14/01/86
		SE 454420 B,C	02/05/88
		SE 8402580 A	15/11/85
		US 4632608 A	30/12/86
EP 0596844 A1	11/05/94	SE 0596844 T3	
		AT 141840 T	15/09/96
		CN 1124683 A	19/06/96
		DE 69304288 D,T	02/01/97
		JP 6190607 A	12/07/94
		SE 9203133 A	28/04/94
		US 5505569 A	09/04/96